Fall 9-28-2018

Recommendation for Best Practice of Pulmonary Artery Catheter Placement in Cardiac Surgery Patients

Hayley Nemeth

RECOMMENDATION FOR BEST PRACTICE OF PULMONARY ARTERY CATHETER PLACEMENT IN CARDIAC SURGERY PATIENTS

by

Hayley Nemeth

A Doctoral Project
Submitted to the Graduate School,
the College of Nursing and Health Professions
and the School of Leadership and Advanced Nursing Practice
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor Of Nursing Practice

Approved by:

Dr. Nina Mclain, Committee Chair
Dr. Michong Rayborn, Committee Member

Dr. Nina McLain Committee Chair	Dr. Lachel Story School Director	Dr. Karen S. Coats Dean of the Graduate School

December 2018

Published by the Graduate School

THE UNIVERSITY OF SOUTHERN MISSISSIPPI®

ABSTRACT

The number one cause of death in the United States is heart disease. With an increased incidence of heart disease, comes an increased rate of cardiac surgeries. One of the more complicated surgeries related to heart disease is the coronary artery bypass graft (CABG) surgery. One practice currently being used regularly is the use of the pulmonary artery (PA) catheter or a Swan-Ganz catheter. The PA catheter is an invasive tool that lies in the patient's pulmonary artery and is often used in CABG surgeries to see how the heart is functioning. However, recent research has shown that these catheters actually are more harmful than beneficial to patients and are very expensive. The purpose of this project was to develop a recommendation for the best practice of PA catheter placement in CABG surgeries based on current literature. This particular surgery is already considered to be a high-risk surgery; therefore, anything that can be done to improve patient outcomes is desirable. A thorough review of the literature and a panel of experts were utilized to develop the recommendation for the best practice of PA catheter placement. The research and the panel of experts agree that best practice of PA catheters is to place a PA catheter based on need, rather than using these catheters without discretion in patients undergoing CABG surgeries. Also, if available, anesthesia providers should try to use less invasive alternatives to the PA catheter.

ACKNOWLEDGMENTS

I would like to thank Dr. Nina McLain for all of her time, support, and guidance throughout completing this project. I would also like to thank Dr. Michong Rayborn for her help throughout this process.

DEDICATION

I would like to dedicate this project to my family, especially my amazing parents. I could not have done this without your constant love and support. I would also like to dedicate this paper to Yasmin Godsmark, a friend and former co-worker, who lost her battle with lung cancer this year. Yasmin gave me the original inspiration for this paper and she is greatly missed.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

CABG	Coronary Artery Bypass Grafting surgery
CRNA	Certified Registered Nurse Anesthetist
DNP	Doctor of Nursing Practice
PA	Pulmonary Artery
USM	The University of Southern Mississippi

CHAPTER I - INTRODUCTION

Background and Significance

The usage of pulmonary artery (PA) catheters in coronary artery bypass graft surgeries have been the source of debate for some time now. A PA catheter is a balloon-tipped catheter whose tip lies in the patient's pulmonary artery and is used to monitor specific hemodynamic data (Schwann et al., 2011). Some physicians are moving away from using these catheters for these surgeries and some physicians insist on having them for every cardiac surgery. Recent studies have questioned the effectiveness and safety of these catheters (Xu, Wang, Zhang, Chen, & Ao, 2015). The population that this practice affects is patients undergoing coronary artery bypass grafting (CABG) surgery. These patients often have several comorbidities, to begin with, so anything that can be done to improve outcomes is highly beneficial to this population. Some of these comorbidities include diabetes mellitus, hypertension, hyperlipidemia, obesity, peripheral vascular disease, chronic liver disease, and chronic obstructive pulmonary disease (Xu et al., 2015).

The use of the PA catheter has been debated since its introduction into practice over 40 years ago, but several studies state that the benefits of the usage outweigh the risks, while other studies show higher mortality rates in patients who require PA catheters (Xu et al., 2015). According to Schwann et al. (2011), their study found that not only was the use of PA catheters associated with increased mortality and complications, but it also indicated that the use of the PA catheter triggered more frequent intervention. Determining whether the usage of PA catheters is harmful or beneficial is extremely important because the usage of PA catheters does increase mortality rates in CABG

patients. CABG surgeries are already considered high-risk procedures and anything that can be done to decrease mortality rates should be done. According to Xu et al. (2014), their study found that there was “no clear indication of any benefit or harm in managing CABG patients with PAC”, but they did find that the usage of PA catheters was more expensive. Therefore, another problem that the usage of PA catheters brings up is that of cost. If there is no clear risk or benefit that brings up the question of whether they should even be used if they are more expensive. Not only do we want to provide best practice for patients, but we also want to be cost-effective if possible. Most studies have come to the consensus that the PA catheter should only be used when indicated to manage a specific patient and not just used purely because the patient is undergoing cardiac surgery. If the PA catheter is not indicated, then it should not be used. The desired outcome for this population is to have a successful surgery and to have little to no complications associated with this procedure.

Project Question/Recommendation

According to the current literature, the recommendation for best practice of PA catheters is to place a PA catheter based on need, rather than using these catheters without discretion. Although PA catheter usage has been the practice for the past 40 years, plenty of literature is available now that shows that the risks may outweigh the benefits. Several adverse events can occur due to the placement of these catheters. These adverse events are defined as myocardial infarction, cerebrovascular accident, arrhythmias, pneumothorax, renal failure, and death (Xu et al., 2015). These events could potentially be avoided by not using PA catheters.

Purpose of the Project

The purpose of this project is to recommend the best practice for use of PA catheters in patients undergoing cardiac surgery based on the most current literature. With new technology, the PA catheter could be an outdated practice. The patients having these surgeries already have an increased likelihood of adverse events; therefore anything that can be done to reduce any risks is desirable.

Theoretical and Conceptual Framework

The Neuman Systems Model is a theoretical framework that can be applied to this project. This model includes the major concepts dealing with human beings, environment, health, and nursing. Based on the variables within this model, the main concern of nursing is to define the appropriate actions in situations that can cause stress to a human (Ume-Nwagbo, DeWab, & Lowry, 2006). Stressors are defined as any situation that might impede the lines of defense, resulting in either a positive or negative result (Ume-Nwagbo et al., 2006). When applied to this project, the PA catheter would be the stressor and the goal would be to remove the stressor to improve the physiological variable. In this particular project, the stressor (PA catheter) would be causing a negative result (adverse event).

Needs Assessment

Heart disease is the number one cause of mortality in the United States, and CABG surgery is the most common type of heart surgery performed in the United States (U.S. Department of Health and Human Services, 2018). In particular, Mississippi has an extremely high incidence of heart disease (Mississippi Department of Health, 2014). According to the Mississippi Department of Health (2014), cardiovascular disease is the

leading cause of death in Mississippi and is responsible for over one-third of all deaths in the state. Mississippi's cardiovascular disease mortality rate is the highest in the United States (Mississippi Department of Health, 2014). Mississippi also ranks second in the nation for overall diabetes and obesity prevalence (Mississippi Department of Health, 2014). Diabetes and obesity are two major modifiable risk factors that lead to heart disease. These statistics are extremely relevant because based on those statistics that would mean that more people in Mississippi would be likely to need heart surgery. Therefore, utilizing every best practice possible and the safest tools available is crucial.

Doctor Of Nursing Practice Essentials

The American Association of Colleges of Nursing (AACN) created the Doctor of Nursing Practice (DNP) Essentials to ensure that individuals pursuing a DNP degree are prepared for specialized nursing practice and are prepared for the highest level of leadership (American Association of Colleges of Nursing, 2006). This paper incorporates several of these essentials that have been outlined by the AACN. The DNP essentials this paper incorporated are further discussed in Appendix F.

Review of Evidence

An evidence search was completed to research articles that discussed the risks and benefits of PA catheters in patients undergoing cardiac surgery. Several databases were searched including CINAHL, Academic Search Premier, Alt Healthwatch, EBSCO, Healthsource, and Medline. Key search terms included were: pulmonary artery catheter, coronary artery bypass graft surgery, infections, co-morbidities, and effectiveness. An initial search with limitations to full text only and publication dates between 2005 and 2018 returned 117 articles. Of these 117 articles, 7 articles were selected because they are

strongly applicable to this project. A literature matrix is included with information from each of the included articles.

Coronary Artery Bypass Graft Surgery

Coronary artery bypass grafting surgery (CABG) is a type of surgery that is performed to improve blood flow to the heart in patients with severe heart disease. Coronary heart disease causes a buildup of a substance called plaque in the coronary arteries. The build of plaque in these oxygen-rich arteries causes a narrowing in the arteries and a decrease of oxygen-rich blood flow to the heart (U.S. Department of Health and Human Services, 2018). Also, if this plaque ruptures a blood clot can form on the surface that can cause a partial or complete blockage of blood flow to the heart, which can lead to a heart attack. CABG surgery is one particular treatment for this type of problem. In this surgery, a healthy vein or artery from the body is grafted to the blocked artery and the grafted vein or artery goes around the blocked portion of the artery (U.S. Department of Health and Human Services, 2018). This procedure creates a new way for the oxygen-rich blood to get to the heart. Several coronary arteries can be bypassed in one surgery. This surgery is the most common type of open-heart surgery in the United States (U.S. Department of Health and Human Services, 2018).

PA Catheter

The PA catheter is a flow-directed balloon-tipped catheter that is placed in the pulmonary artery. The PA catheter was first introduced in the 1970s to help manage acute myocardial infarction (heart attack) and was used significantly as a hemodynamic monitoring device (Paunovic, 2017). This catheter is an invasive tool that is capable of diagnosing and managing several different kinds of health problems. When this catheter

is properly placed, it can help the healthcare provider learn more about the pressures in the right side of the heart and in the arteries of the lung (Johns Hopkins Medicine, 2018). Due to the ability of the PA catheter to measure pressures in the heart and lung, it became an important part of anesthesia management for cardiac surgery. However, due to its invasiveness, complications, and introduction of less invasive hemodynamic monitoring technologies in recent years, the use of the PA catheter has decreased significantly over the years (Judge, Ji, Fleming, & Liu, 2015).

Newer Technologies

In recent years, there have been several new technologies created that can perform the same function as the PA catheter but are much less invasive. Three examples include the PiCCOplus System, the LiDCO system, and the FloTrac/Vigileo system. All three of these technologies utilize pulse pressure analysis to obtain measurements. Pulse pressure analysis is "based on the principle that stroke volume can be continuously estimated by analyzing the arterial pressure waveform obtained from an arterial line" (Alhashemi, Cecconi, & Hofer, 2011). The PiCCO system utilizes a catheter, which is normally placed in the femoral artery, but the radial or brachial artery can be used (Alhashemi et al., 2011). The LiDCO system uses a technique that can be performed using a peripheral venous line. The FloTrac/Vigileo system utilizes a transducer that can be connected to a radial arterial line (Alhashemi et al., 2011). Peripheral venous lines and arterial lines are two lines that are already required for CABG surgery and not nearly as invasive as a PA catheter. The FloTrac/Vigileo system has recently shown a decreased complication rate and a reduced length of hospital stay in a recent study (Alhashemi et al., 2011).

Yet another technology that is becoming popular in CABG surgeries is the use of esophageal Doppler probes (Alhashemi et al., 2011). Esophageal dopplers are capable of measuring cardiac output non-invasively by using esophageal or transthoracic Doppler probes (Alhashemi et al., 2011). These devices "measure blood flow in the descending aorta and estimate cardiac output by multiplying the cross-sectional area of the aorta by blood flow velocity" (Alhashemi et al., 2011).

Evidence Review Conclusion

From the evidence reviewed for this project, all authors concluded that there was either a risk when using the PA catheters or that there was no clear risk or benefit involved with PA catheter usage. Schwann et al. (2011) studied a large population and found that the use of the PA catheter specifically for CABG surgery was associated with an increased mortality and increased risk of severe end-organ complications. A study performed later by Xu et al. (2015) found that there was no clear risk or benefit but that there was increased cost when PA catheters are used for CABG surgery. Koo et al. (2011) found that there has been a major decrease in the usage of PA catheters and that several randomized trials have failed to establish a clear benefit of PA catheters. Another study also found that usage of PA catheters has declined in the last 20 years that was suggestive of physicians' willingness to change practice based on new evidence (Gershengorn & Wunsch, 2014). Yet another study based on a review of 12 other studies found that PA catheters do not lead to a positive outcome for patients (Paunovic, 2017). This article also went on to agree that PA catheters should only be placed in select patients and only performed by well-trained health care professionals (Paunovic, 2017).

Two different studies showed that a majority of cardiac anesthesiologists still prefer to use PA catheters for CABG surgeries. This indicates a gap in best practices based on current literature and what is actually happening in the clinical setting. One study showed that 63% of anesthesiologists did not feel that the usage of a PA catheter increased risk but in that same study 67% of anesthesiologists felt influenced to place the catheter due to surgeon's request (Kanchi, 2011). Another study performed by Judge et al. (2015) also found that placement could be due to strong encouragement from cardiac surgeons. It is concerning that the surgeon's influence could be preventing the anesthesia providers from providing patients with best practice care. The evidence suggests that there is more harm than good from using the PA catheters; therefore there needs to be the dissemination of this information due to the fact that anesthesiologists still prefer their use (Kanchi, 2011).

Summary

Chapter I outlined the background, significance, purpose, theoretical framework, and needs assessment for this project. The best practice recommendation based on the most recent evidence was defined in this chapter. This chapter also included the review of evidence that was necessary to complete this project. The next chapter discusses the methods used to complete this project.

CHAPTER II – METHODS

Context

Based upon the information gathered for this project the recommendation for best practice for PA catheters is for placement based on each patient's medical history and severity rather than in all patients undergoing CABG surgery. After approval from the IRB was obtained from The University of Southern Mississippi (18071901) and approval from the head anesthesiologist in the anesthesia department at Anderson Regional Medical Center, I spoke with a panel of experts from Anderson Regional Medical Center about the findings from my research about PA catheters. This panel included: the head CRNA and anesthesiologist, cardiovascular surgeon, and CRNAs that provide anesthesia for CABG surgeries at the facility. The members of the panel were each chosen specifically because they each play a direct role in the care of patients undergoing CABG surgery.

Target Population

The target population for this project was health care providers that provide direct care to patients undergoing CABG surgery. This panel of experts included a combination of 13 total participants. This population was also chosen because all of these providers make the ultimate decision of placing a PA catheter or not placing a PA catheter. The CRNAs and anesthesiologists are the healthcare providers that place the PA catheters for these surgeries and monitor the patients using the PA catheter throughout the surgery. The cardiovascular surgeon is essentially fully in charge of everything that goes on with the patient; therefore it was absolutely necessary for the cardiothoracic surgeons to be part of the panel.

Data Collection/Analysis

The guidelines for the best practice recommendation were developed and presented to the panel of experts. After the presentation of the information, a short 5-question survey was presented to the panel to address concerns and feedback. Based on the feedback from the surveys completed by the panel of experts, changes to the best practice recommendation were made. After the best practice recommendation was finalized, the final draft was presented to the head anesthesiologist and head CRNA at Anderson Regional Medical Center. These findings and the final revised guidelines were then presented at the University of Southern Mississippi DNP Scholarship Day in fall 2018.

Summary

Chapter II described the methods used to complete this project. The contexts of the methods were explained and the target population was described. The data collection and analysis utilized were also discussed in this section. The following chapter discusses the results from the data discussed in this chapter.

CHAPTER III - RESULTS

This DNP project utilized a best practice recommendation based on the most recent literature and a 5-question survey given to a panel of experts. The tools used for this project can be found in Appendices D and E. This panel of experts included: the head CRNA, head anesthesiologist, cardiothoracic surgeon, and 10 CRNAs that take care of CABG patients peri-operatively at Anderson Regional Medical Center. All of these participants were chosen due to their direct and vital role in the care of a CABG surgery patient. The participants were asked to read the best practice information provided and then complete the survey provided. All of the participants agreed that the information provided was relevant to their institution, that they would be willing to adopt this best practice, and that the information provided was evidence-based. Only two participants answered no to question 1, which inquired if the information provided was new information regarding PA catheter use. This information means that the other 11 participants were given new information based on the best practice recommendation created from this project. All of the participants were willing to change their practice based on this information, which is a positive outcome and could potentially help future patients avoid having to have an unnecessary PA catheter placed.

Summary

This chapter analyzed the results from the surveys that were completed by the panel of experts. The data that was collected reconfirmed that the recommendation for best practice for PA catheters is evidence-based and that all participants would be willing to change their current practice to meet this best practice. The final chapter examines the importance of the information analyzed in this project.

CHAPTER IV – DISCUSSION

Summary

The purpose of this DNP project was to recommend the best practice for PA catheters in patients undergoing CABG surgery. Throughout completion of this project, several DNP Essentials were met and can be found in Appendix E. According to the current literature, the final recommendation for best practice of PA catheters is to place a PA catheter based on need, rather than using these catheters without discretion in patients undergoing CABG surgeries. Also, if available, anesthesia providers should try to use less invasive alternatives to the PA catheter. The panel of experts agreed that the recommendation was evidence-based and that they would be willing to use the recommendation in their everyday practice. This information is promising because the experts that participated in this project currently take care of several patients undergoing CABG surgery every day.

Interpretation

PA catheters do still play a role in a very specific patient population but should not be placed in every patient undergoing CABG surgery. These patients often have several co-morbidities and not using an invasive tool that may not be necessary is a way to lessen the risk of adverse outcomes. Based on the findings of this project, it seems that surgeon preference is a large factor in the usage of PA catheters and people set in their ways of using an outdated practice rather than evidence from the most recent literature. The PA catheter is a tool that was created in the 1970s and since then several new tools have been created that are just as good as the PA catheter but are less invasive. The newer

technologies mentioned earlier, the PiCCOplus System, the LiDCO system, and the FloTrac/Vigileo system, are just three examples of better alternatives.

Future Implications

Yet another important aspect to consider in regard to PA catheters is that of cost. One study found that the PA catheter has no clear risk or benefit, but that it costs more (Xu et al., 2015). In the current times, healthcare costs have become astronomical and it is the duty of advanced practice nurses to advocate for patients physical and financial well-being. Future studies regarding PA catheters could explore this aspect by completing a cost analysis of PA catheters verse central venous lines. Central venous lines, also known as central lines, are catheters that are placed in a large vein in the neck, chest, groin, or arm to give fluids, blood, or medications quickly (Centers for Disease Control and Prevention, 2010). Central venous lines are an alternative to PA catheters, but if the surgeon wants to measure certain pressures in the heart, the anesthesia provider would have to utilize one of the less invasive alternatives to PA catheter as well as the central venous line. These patients need a lot of intravenous access to get fluid and vasoactive medicines in quickly during surgery and this can be done by using a central venous line rather than using a PA catheter.

Limitations

One limitation of this project is when there is a complication in a patient who has a PA catheter. This patient is sicker than an average patient. Patients undergoing heart surgery commonly have several other comorbidities and have compromised heart function. Therefore, it is hard to discern whether the complication is from the PA catheter

or it is from one of the patient's other comorbidities. One of the participants in the panel of experts mentioned this limitation in their survey, which is a valid point.

Conclusion

In conclusion, patients undergoing CABG surgery are ill patients and by utilizing this best practice recommendation it is possible to help improve patient outcomes. The literature clearly states that PA catheters cause more harm than benefit or have no clear benefit and are potentially more expensive. There are several new technologies that can and should be utilized that could help decrease adverse outcomes. The healthcare field is ever-changing, and health care providers need to adapt to technology and utilize the best tools that are available. The priority in the healthcare field is always the patient and by utilizing the best practice recommended in this project healthcare providers can improve health outcomes by avoiding the usage of an unnecessary tool.

APPENDIX A – Literature Matrix

Author/Year/ Title	Level	Design	Sample/ Data Collec-tion	Findings	Recommendations
Schwann, Hillel, Hoeft, Barash, Mohnle, Miao, & Mangano (2011). Lack of Effectiveness of the Pulmonary Artery Catheter in Cardiac Surgery.	III	Prospect-ive observat-ional study design	5065 CABG patients from 70 centers.	Use of PAC during CABG surgery was associated with increased mortality and increased risk of severe end-organ complications.	An RCT with defined hemodynamic goals would be ideal to either confirm or refute findings.
Xu, Wang, Zhang, Chen, & Ao (2015). Use of Pulmonary Artery Catheter in Coronary Artery Bypass Graft. Costs and Long-Term Outcomes.	III	Retrospe-ctive observat-ional study design	1361 patients who consecu-tively had isolatedp rimary CABG from June 1, 2012, to Decem-ber 31, 2012, at Fuwai Hospital in Beijing, China.	No clear indication of benefit or harm in managing CABG patient with PAC, however using the PAC is more expensive.	The evaluation of a PAC in clinical practice with an RCT would be beneficial. Usage of a PAC is not recommended because there is neither a clear benefit nor harm but it is more expensive.
Koo, Sun, Zhou, Guyatt, Cook, & Meade (2011). Pulmonary artery catheters: Evolving rates	IV	A multi-center longitud-inal study using the Hamilton Regional Critical	Patients from five ICUs who received a PA catheter within the first 2	There was a >50% reduction in the rate of pulmonary artery catheter use over 5 yrs. Patient factors predicting	There has been a decline in the usage of PA catheters and randomized trials have failed to establish a clear benefit of PACs.

and reasons for use.		Care Database.	days of ICU admissi-on.	pulmonary artery catheter use were illness severity, specific diagnoses, and the need for advanced life support.	
Kanchi (2011). Do we need a pulmonary artery catheter in cardiac anesthesia? - An Indian perspective.	VI	Qualitat-ive study of question-naires.	One hundred cardiac anesthe-siologis-ts.	63% of the respondents felt that the use of PAC in cardiac surgery does not increase the risk, and 67% felt that the surgeon's request influenced in floating a PAC. 83% of the anesthesiologis ts preferred using a PAC that has continuous cardiac-output-monitoring.	This study found that the PAC is a useful technique for monitoring physiological function. PAC is a monitoring tool, and the tool should be used by highly trained professionals and will utilize the data appropriately.
Gershengorn & Wunsch (2014). Understandi-ng changes in established practice: pulmonary artery catheter use in critically ill patients.	IV	Cohort study.	Adult ICU admissio ns from 2001-2008. US ICUs in Project IMPACT .	Use of PACs has declined, but with significant variation across different units.	The overall use of PACs in the ICU setting has declined over the past 20 years, suggest willingness by physicians caring for critically ill patients to change practice based on new evidence. High use of PACs is more consistently found in certain practice settings and for specific types of patients.
Judge, Ji, Fleming, & Liu (2015).	VI	Survey study.	SCA members in North	The results of this study suggested that	Results show that a majority of cardiac anesthesiologists were

Current use of the pulmonary artery catheter in cardiac surgery: A survey study.			America, Europe, Asia, Australia, New Zealand, and South America.	a majority of the respondents still prefer to use the PAC for most cardiac surgeries.	still placing a PAC for most of their cardiac surgeries. Whether this was by personal choice or because of strong encouragement from cardiac surgeons remains unclear.
Paunovic (2017). Pulmonary artery catheterization.	V	Literature review	Review of 12 studies	The literature does not show a positive effect on the patient outcome with PAC use.	Analysis shows that there is a decrease in the use of PA catheters. PA catheters should only be used in select patients and only by well-trained healthcare professionals.

APPENDIX B – Permission Letter

Dear Dr McLain,

We are happy to work with Hayley Nemeth on his doctoral project as one of our quality improvement initiatives. Once we have confirmation that the USM IRB has approved this project, I will discuss this project with the Anderson Regional Medical Center risk management team. We look forward to this opportunity.

Thank you,

Jason Coleman CRNA, DHA
Chief Nurse Anesthetist
Meridian, MS

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APPENDIX C – IRB Approval Letter

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 18071901
PROJECT TITLE: Recommendation for Best Practice of Pulmonary Artery Catheter Placement in Cardiac Surgery Patients
PROJECT TYPE: New Project
RESEARCHER(S): Hayley Nemeth
COLLEGE/DIVISION: College of Nursing and Health Professions
DEPARTMENT: School of Leadership and Advanced Nursing Practice
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Exempt Review Approval
PERIOD OF APPROVAL: 07/27/2018 - 07/26/2019
Edward L. Goshorn, Ph.D.
Institutional Review Board

APPENDIX D – Survey Tool

The University of Southern Mississippi
Hayley Nemeth
Recommendation for Best Practice of PA Catheters Placement in Cardiac Surgery Patients

Participation in this anonymous survey is voluntary. There are no repercussions for non-participation. Thank you for your time.

Survey

Please circle yes or no.

1. Does this best practice information give you new information regarding pulmonary artery catheter use? **Yes** **No**
2. Is the information provided relevant to your institution? **Yes** **No**
3. Would you consider adopting this best practice? **Yes** **No**
4. Was the information provided evidence-based? **Yes** **No**
5. Comments/concerns:

_____
_____
_____
_____
_____
_____

THANK YOU FOR PARTICIPATING IN THE SURVEY.

Hayley Nemeth, SRNA

APPENDIX E – Best Practice Recommendation

Recommendation for Best Practice of Pulmonary Artery Catheter in Cardiac Surgery Patients

Hayley Nemeth
The University of Southern Mississippi

Purpose: The purpose of this project is to recommend the best practice for usage of PA catheters in patients undergoing cardiac surgery based on the most current literature. With new technology, the PA catheter could be an outdated practice. The patients having these surgeries already have an increased likelihood of adverse events, therefore anything that can be done to reduce any risks is desirable.

Background and Significance: There has been debate over the use of the PA catheter since its introduction into practice over 40 years ago, but several studies state that the benefits of the usage outweigh the risks, while other studies show higher mortality rates in patients who require PA catheters (Xu, Wang, Zhang, Chen, & Ao, 2015). According to Schwann et al. (2011), their study found that not only was the use of PA catheters associated with increased mortality and complications but it also indicated that the use of the PA catheter triggered more frequent intervention. Determining whether the usage of PA catheters is harmful or beneficial is extremely important because if the usage of PA catheters does indeed increase mortality rates in CABG patients than the practice use needs to be reconsidered. CABG surgeries are already considered high-risk procedures and anything that can be done to decrease mortality rates should be done. Most studies have come to the consensus that the PA catheter should only be used when indicated to manage a specific patient and not just used purely because the patient is undergoing cardiac surgery. If the PA catheter is not indicated, then it should not be used. The desired outcome for this population is to have a successful surgery and to have little to no complications associated with this procedure.

Materials and Methods: Recommendation based on a review of the most recent literature.

Summary of Evidence

From the literature reviewed for this project, all authors concluded that there was either a risk when using the PA catheters or that there was no clear risk or benefit involved with PA catheter usage. Schwann et al. (2011) studied a large population and found that the use of the PA catheter specifically for CABG surgery was associated with an increased mortality and increased risk of severe end-organ complications. A study performed later by Xu et al. (2015) found that there was no clear risk or benefit but that there was increased cost when PA catheters are used for CABG surgery. Koo et al. (2011) found that there has been a major decrease in the usage of PA catheters and that several randomized trials have failed to establish a clear benefit of PA catheters. Another

study also found that usage of PA catheters has declined in the last 20 years that was suggestive of physicians' willingness to change practice based on new evidence (Gershengorn, H. & Wunsch, H., 2014). Yet another study based on a review of 12 other studies found that PA catheters do not lead to a positive outcome for patients (Paunovic, B., 2017). This article also went on to agree that PA catheters should only be placed in select patients (Paunovic, B., 2017). Two different studies did show that a majority of cardiac anesthesiologists still prefer to use PA catheters for CABG surgeries. In one of those studies, 67% of anesthesiologists felt influenced to place the catheter due to the surgeon's request (Kanchi, M., 2011). Another study performed by Judge et al. also found that placement could be due to strong encouragement from cardiac surgeons (2015). This shows that there is potentially a gap in best practice based on current literature and what is actually happening in the clinical setting.

There are also less invasive alternatives to the PA catheter. In recent years there have been several new technologies created that can perform the same function as the PA catheter but are much less invasive. Three examples include the PiCCOplus System, the LiDCO system, and the FloTrac/Vigileo system. All three of these technologies utilize pulse pressure analysis to obtain measurements. The PiCCO system utilizes a catheter, which is normally placed in the femoral artery, but radial or brachial artery can be used (Alhashemi et al, 2011). The LiDCO system uses a technique that can be performed using a peripheral venous line. The FloTrac/Vigileo system utilizes a transducer that can be connected to a radial arterial line (Alhashemi et al, 2011).

Recommendation: According to the current literature, the recommendation for best practice of PA catheters is to place a PA catheter based on need, rather than using these catheters without discretion in patients undergoing CABG surgeries. Also, if available, anesthesia providers should try to use less invasive alternatives to the PA catheter.

APPENDIX F – DNP Essentials

Doctor of Nursing Essentials	How the Essential is Achieved
I. Scientific Underpinnings for Practice	A review of current literature for best practice of PA catheters and complications associated with PA catheters was performed. The information gathered was used to create a best practice recommendation for this project.
II. Organizational and Systems Leadership for Quality Improvement and Systems Thinking	The aim of this DNP project was to inform anesthesia providers of what the best practice for usage of PA catheters should be in patients undergoing CABG surgery to help improve patient outcomes.
III. Clinical Scholarship and Analytical Methods for Evidence-Based Practice	This entire project is based on the most current literature and evidence-based practice for usage of PA catheters.
IV. Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care	Utilization of alternative newer technologies has been determined to be superior to PA catheters based on the results of this project.
VI. Interprofessional Collaboration for Improving Patient and Population Health Outcomes	This DNP project included CRNAs, anesthesiologists, and cardiac surgeons in the panel of experts.
VIII. Advanced Nursing Practice	The evaluation of evidence-based literature and educating health care providers about best practice are components of advanced practice nursing.

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